

of the sheets is a matrix of transparent conductive blocks, thin film transistors, a group of conducting addressing lines, and a group of conductive addressing columns. Each transistor has a gate connected to a line, a source connected to a block, and a drain connected to a column. On the second sheet is a counter electrode. On top of the liquid crystal material is attached a flexible transparent film which has patterned thin film semiconductor layers preferably comprising a layer of i(intrinsic)-type semiconductor disposed between a layer of p-type semiconductor and a layer of n-type semiconductor. The p-i-n layer is further sandwiched on either side by a thin layer of transparent conductive layer such as tin oxide, indium tin oxide, or the like to constitute a p-i-n junction amorphous silicon solar cell.

[0115] A silicon solar cell connected to the emitter of a common base amplifier biased so that the cell voltage is near to zero, a short-circuit load can be used as a sensor. Collector load is three forward diodes which develop an approximately logarithmic voltage versus current in the current ranges involved. The next stage provides the AC coupling for the pulses, so that the sensitivity of the sensing system is essentially independent of the light level on the cell. This stage is an operational amplifier with a bypass on the feedback for high AC gain and low direct current DC gain. This network also has a low-pass net to reject noise spikes picked up from the environment. The coverage of the conductive layers by an actuating finger causes shadowing which results in a decreased current output proportional to the area shadowed.

[0116] A preferable p-i-n junction amorphous silicon solar cell 140 is shown in FIG. 10B. This p-i-n junction amorphous silicon solar cell 140 includes nine layers 141-149. Layer 141 is a transparent conductive tin oxide layer. Layer 142 is a transparent layer of p-type semiconductor. Layer 143 is a transparent layer of i-type semiconductor. Layer 144 is a transparent layer of n-type semiconductor. Layer 145 is a transparent conductive tin oxide layer. Layer 146 is a transparent insulating silicon-dioxide layer. Layer 147 is a transparent layer containing a horizontal or vertical electrical grid. Layer 148 is a transparent insulating silicon-dioxide layer. Layer 149 is a transparent layer containing a horizontal or vertical electrical grid. Once this p-i-n junction amorphous silicon solar cell 140 is attached to an LCD, the solar cell 140 is covered with a transparent plastic layer to protect the cell from the environment. In actuality the solar cell and associated layers are deposited on the plastic layer which is then inverted and attached to the glass.

[0117] The p-i-n junction amorphous silicon solar cell is scribed into smaller portions comprising one primary portion and at least one peripheral secondary portion (preferably four secondary portions around the primary portion) to configure an electronic cluster key. The p-i-n junction amorphous silicon solar cell include at least one vertical and horizontal grid of transparent conductors laid in between two transparent insulating layers of the thin film variety such as silicon dioxide. The p-i-n junction amorphous silicon solar cell's two conductive transparent coatings of tin oxide, indium tin oxide, or the like, can be combined in series using techniques well known to persons skilled in the art to provide a trickle charge at approximately 12-14 volts. One approach to series connection entails using a laser to scribe and separate the initial tin oxide coating into islands, using a photoresist mask on the edge to prevent the subsequent

layers off p,i,n from touching the conductive layer. Thereafter, the mask is removed and the second tin oxide layer is applied which connects the top surface of the second cell to the bottom surface of the first cell, resulting in a series connection. Other intervening steps are well known to those skilled in the art. The p-i-n junction amorphous silicon solar cell may include capacitors and/or pressure sensors at the center of each key which are all deposited on a flexible transparent substrate such as Kapton and then glued on to the LCD. Kapton or other high temperature plastic is used to withstand high temperatures associated with chemical vapor deposition of amorphous silicon. It is possible to integrate the processing of the solar cell and the LCD based on active matrix thin film transistors (TFTs).

[0118] The LCD is preferably an active matrix TFT display which preferably displays the primary key as a white key with black characters for most contrast and which preferably displays the secondary key alphabet characters in a particular color such as red. Preferably secondary key function symbols are displayed in green, secondary key characters such as the AT sign (@) are displayed in blue, and secondary key control symbols such as, YES/SEND are displayed in yellow with green letters and NO/END are displayed in yellow with red letters. Obviously, a variety of other color assignments are possible.

[0119] The cluster key arrangement is configured utilizing a keyboard emulator within the remote telephone in accordance with the mode selected by the user using the mode switch. FIG. 10A illustrates one arrangement showing a cluster key arrangement comprising a set of twelve cluster keys arranged in four rows by three columns. The primary key for a particular cluster key is preferably displayed in the form of a circularly, ellipsoidally, pentagonally, etc., shaped image as viewed from the top. The secondary keys are each preferably displayed in the form of a rectangularly, trapezoidally, or semi-circularly, shaped image which may be elongated to provide more finger contact. Each electronically configured cluster key includes a primary key location 138 surrounded by at least one secondary key location 140. By touching a particular key location on the touch screen LCD 132, the user activates an electrical signal which passes through an electrical matrix formed by a plurality of contact lines 142 interconnecting each of the particular key locations. The electrical signal is delivered to a processing unit stored within the remote telephone 120, which is then converted into a symbol and displayed on the LCD 130. The remote telephone also includes circuitry which precludes the simultaneous activation of more than one key location of a particular cluster key.

[0120] The electronic or opto-electronic mutually exclusive cluster key arrangement works on the same basis of preprocessing as was done in the mechanical cluster key arrangements wherein only one signal could be generated at a time. In the electronic cluster key arrangement the preprocessing is based on sensing one or more variables such as contact pressure or shadowing of a solar cell's microcell element. Both analog levels and digital/logical inputs are used in preprocessing. Other types of sensing such as capacitive is also possible. Appropriate grid work of conductors and electronics which is well known to those skilled in the art will be used, entailing the use of digital and analog multiplexers, operational amplifiers polling elements and the like. In a pure LCD cluster key arrangement, wherein a